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Publications taken into consideration when judging patentability:

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The following specifications are taken from the documents submitted by the applicant

Process and device for operating voice-supported systems in motor vehicles

The invention relates to a process as well as a device for operating voice-supported systems, such as communication and/or intercommunication devices in motor vehicles, in which with a multimicrophone configuration voice signals are picked up and conducted further to at least one loudspeaker. In order to ensure in a process as well as a device of this type that feedbacks are eliminated, the invention proposes that the voice signal or the voice signal spectrum is first shifted in frequency by a small amount ΔF and only subsequently is supplied to the loudspeaker(s) or the input of a voice-controlled device.

Specification

The invention relates to a process as well as a device for operating voice-supported systems, such as communications and/or intercommunication devices in motor vehicles, in which via a multimicrophone configuration voice signals are received and conducted further to at least one loudspeaker, according to the preamble of patent claim 1 and 7.

Processes of this type are used in motor vehicles for one, for voice supported duplex operation or also for supporting voice input-controlled electronic or electric assemblies. The fundamental problematic encountered herein is that in motor vehicles, depending on the operating state, corresponding background noise effects are present. These effects cover the voice commands. Intercommunication systems in motor vehicles are primarily of advantage in large vehicles, minibuses and the like. However, they can also be used in normal passenger vehicles. When used in voice-controlled input units for electric components in a motor vehicle the suppression of the background noises or the filtering-out of the voice command is of great importance.

From EP 0078014 B1 is known a voice recognition device for motor vehicles in which into the amplifier system of the voice recognition device a message is entered via sensors, regarding whether or not the motor is in operation and/or whether the motor vehicle is moving. Depending on the result, the level is affected, which attempts to filter out the voice command from the background noise.

From DE 37 42 929 C1 is known a configuration with two microphones, wherein one of the microphones is disposed at the mouth of the operating person and another one in the proximity, however, this is intended for picking up the body sound. Both microphone signals are triggered such that the body sound can be subtracted from the total sound.

From DE 197 05 471 A1 is known to support a voice recognition with the aid of transverse filtering. Herein a frequency analysis is carried out which, however,

serves only for the purpose of voice command recognition. No background noise compensation takes place herein.

From WO 97/34290 a filtering is known in which periodic noise signals are filtered out, thereby that their period is determined and, by means of a generator, is interfered out such that the voice signal remains.

From DE 41 06 405 C2 is known a process in which noise subtraction from the voice signal takes place, wherein a multiplicity of microphones is used.

From DE 39 25 589 A1 the use of a multimicrophone configuration is known wherein, when applied in motor vehicles, one of the microphones is disposed in the engine compartment and a further one in the passenger compartment. A subtraction of both signals takes place. Of disadvantage is herein that only the engine noise or the operating noise proper of the motor vehicle itself is subtracted from the total signal in the passenger compartment. Specific background noises are herein not taken into account. Also absent is a feedback suppression which represents a special set of problems. Wherever microphones and loudspeakers are disposed in acoustically couplable proximity, it may occur that the acoustic signal coupled out at the loudspeaker, feeds back into the microphone. A so-called feedback occurs and a super.. {illegible} superimposed on it.

Consequently, the objective of the invention is to further develop a process as well as a device of the type according to the species to the extent that feedbacks and instabilities are suppressed which occur in configurations of several microphones and loudspeakers.

This objective is solved in a process of the type according to the species through the characterizing characteristics of patent claim 1.

Further advantageous developments of the process are specified in claims 2 to 5.

With respect to a device of the type according to the species, the posed objective is solved according to the invention through the characterizing characteristics of patent claim 6. Further advantageous developments of the invention in terms of device are specified in the remaining claims.

With respect to the process as well as also the device, the invention builds on a communication and/or intercommunication system in motor vehicles. It is also known to dispose herein a multimicrophone configuration, to pick up voice as well as also background noise signals in addition and to subtract from the total signal the background noise signals such that, after filtering, the voice signal remains.

According to the objective, the core of the invention comprises that the particular microphone signal is first frequency-shifted by a small amount ΔF, and only subsequently is conducted to the loudspeaker(s) or to the input of a voice-controlled device. The frequency shift according to the invention, which is herein carried out at a defined site and is not random, supports, for one, the filtering and, for another, feedbacks, thus also the echo signal, are coupled out.

Since feedbacks without said frequency shift according to the invention are nothing other than the fedback amplified voice signal, such feedbacks cannot be eliminated with means and methods from the cited prior art. This cannot be done for said reason since devices of known type only separate the voice signal from the background noise signal and identify the fedback signals as a voice signal and not as a background noise signal. Said feedbacks thereby cannot be mastered with the aid of means known within prior art or cannot be mastered simultaneously.

In contrast, however, through the process according to the invention as well as through the device according to the invention, which relates to the interconnection of the discrete elements, feedback effects are elegantly eliminated.

Since the feedback as such occurs causally whenever microphone location and loudspeaker location are in close proximity, which is the case by necessity in motor vehicles, the elimination of this feedback in said application case is of considerable importance. This applies not only in the case of intercommunication operation, in which electro-acoustic feedbacks are unpleasant for the passengers, but is of special significance when used with voice-controlled input interfaces of electric or electronic components in motor vehicles. This applies only if the entire configuration in the motor vehicle comprises microphones as well as also loudspeakers, and the voice-

controlled input into electric apparatus also takes place by way of them. Feedbacks and overdriving resulting therefrom, can cause considerable mal functions and misinterpretations of the voice commands even with intelligent input interfaces. Depending on the application, this also represents a safety risk. The simultaneously background noise elimination can be carried out optionally, i.e. simultaneously.

The invention is depicted in the drawing and, in the following, will be explained in further detail.

The Figure shows the fundamental structure as well as also the operational function, such that based on the Figure itself, the method, as well as also the interconnection of the discrete device elements, can be understood in its logical totality.

In this embodiment example of the invention shown, the interior motor vehicle compartment is divided into two subcompartments, namely the front and the back.

In the front portion is disposed one microphone M1 and one loudspeaker L2.

The microphone M1 receives the voice signal present there and possible noise signals. The noise signal comprises therein the background noise resulting during operation of the motor vehicle in the passenger compartment. These can be engine noises, wind noises as well as roll-off noises or also acoustic echo signals from the other subcompartment and the like. The sum signal at M1 comprised of voice and background noise is supplied to a first summation point S1. To this summation point subsequently a correspondingly processed signal from an acoustic model AM1 front is supplied. The subtraction signal generated in the acoustic model AM1 originates in this embodiment example from the signal obtained in the back compartment of the vehicle and already frequency-shifted. Thereby that this signal coming from M2 and frequency-shifted in F2, which originates in the back subcompartment of the passenger cell, via AM1 in terms of signal technology is also taken into account in the front, the portion generated in the back compartment of the motor vehicle and acoustically transported to the front into the front portion of the passenger cell, which is also registered by M1, is again subtracted at the summation point S1. In other words, through the device AM1 the back subcompartment of the passenger cell is

acoustically separated from the front subcompartment of the passenger cell. This means, first, the totally perceivable acoustic signal is fed into M1, and at the summation point S1 first the echo from the back subcompartment of the passenger cell is subtracted. The original signal received thus in M1 from the front subcompartment of the passenger cell is subsequently supplied to a frequency shifting device F1 and shifted by an amount ΔF, for example by 5 Hz. The output signal from M1 obtained thus is subsequently supplied to loudspeaker L1 of the back subcompartment of the passenger cell and, for another, simultaneously also again fed in the same way into device AM2. AM2 herein represents again the acoustic model for the back subcompartment of the passenger cell. The transmission of a voice message from the back subcompartment of the passenger cell via M2 to the front subcompartment of the passenger cell via L2 takes place analogously, i.e. the microphone M2 registers the voice message together with the background noise in the back subcompartment of the passenger cell and conveys it to the summation point S2, at which the acoustic total signal received via M1, i.e. the echo as well as the ambient noise, is subtracted. The echo-free signal prepared thus from the microphone M2 is subsequently also supplied to a frequency shift device F2, which, in turn, carries out a frequency shift by an amount ΔF. At the output of this frequency shift device F2 the result, or the signal processed thus, is again supplied to the front subcompartment of the passenger cell, namely to the loudspeaker L2 positioned there. The frequency shift for the transmission from the front to the back can also be different from the frequency shift from the back to the front.

Overall, a closed feedback-free system results. The shift of the frequency is an essential characteristic and through the cooperation with the interconnection via the acoustic models AM1 and AM2 the echo elimination from the front to the back subcompartment, and conversely, is given.

However, it is also possible, that, first, for echo suppression and feedback elimination, also a noise signal subtraction is added. This can suitably also be taken into account in the particular acoustic model AM1 and AM2. The furthergoing

components, necessary for this purpose, such as noise signal microphones are therein not represented further.

Consequently, it can be stated that every acoustic input signal from M1 as well as also from M2, before it is further processed and supplied to the loudspeakers L2 or L1, is subtracted from the total background noise signal comprised of echo and remaining noises. Consequently not only an acoustic decoupling between front and back subcompartment takes place, but also the remaining noise signals are quasi compensated or subtracted in one and the same action step.

Patent Claims

1. Process for operating voice-supported systems, such as communication and/or intercommunication devices in motor vehicles, in which, via a multimicrophone configuration, voice signals are received and further conducted to at least one loudspeaker, **characterized in that** the voice signal or the voice signal spectrum, is first frequency-shifted by an amount ΔF and only subsequently is supplied to the loudspeaker(s) or to the input of a voice-controlled device.

2. Process for operating voice-supported systems, as claimed in claim 1 characterized in that in each case before transmission of the signal to the loudspeaker, the echo from the loudspeaker-related ambient field, is subtracted from the signal of the microphone-related ambient field actuated for this purpose.

3. Process for operating voice-supported systems, as claimed in claim 1 or 2, characterized in that when using a multiplicity of microphones, each acoustic receiving signal of each microphone, after subtraction of the particular loudspeaker-related ambient field or the back noise signals generated there, are frequency shifted by ΔF.

4. Process for operating voice-supported systems, as claimed in one or several of the preceding claims, characterized in that for the acoustic coupling or subtraction of the total background noise signals an acoustic model is formed from the received total signals and is supplied in signal technology between particular microphone and particular frequency shift to a particular summation point for the purpose of subtraction.

5. Process for operating voice-supported systems as claimed in claim 4, characterized in that the passenger compartment of the motor vehicle is divided into at least two acoustic subcompartments, such that in each subcompartment at least one microphone location as well as also at least one loudspeaker location is present, that between the microphone location of the one subcompartment and the loudspeaker location of the other subcompartment said frequency shift ΔF takes place and between the loudspeaker locations and microphone location of the one subcompartment and between the loudspeaker locations and microphone locations of the other subcompartment, said acoustic models are used such that in terms of signal technology a closed electro-acoustic regulation circuit is formed.

6. Process for operating voice-supported systems as claimed in one or several of the preceding claims, characterized in that via said acoustic models not only the voice and/or noise signals of the different subcompartments in the passenger cell are taken into account, but rather additionally determined noises existing in the entire ambient field are also taken into account and are subtracted from the total sound signal such that essentially the voice signal remains.

7. Device for operating voice-supported systems, such as communication and/or intercommunication devices in motor vehicles, with a multiplicity of microphones and loudspeakers, as well as with means for transmitting voice messages or voice commands characterized in that the passenger compartment in the motor vehicle is divided into at least two, possibly open, subregions (front, back) with each having at least one microphone (M1, M2) and at least one loudspeaker (L1, L2), that said means comprise also frequency shifting devices (F1, F2) which are interconnected between one of the microphones (M1, M2) and the loudspeaker located in the, in each instance, other subregion

(front, back), and that the resulting loudspeaker signal can be tapped parallel and can be subtractively superimposed via summation points (S1, S2) onto the microphone signal in the same subregion.

8. Device for operating voice-supported systems as claimed in claim 7, characterized in that between parallel taps of the particular loudspeaker signal and the particular summation point (S1, S2) means (AM1, AM2) are provided via which so-called acoustic models can be generated, which affect/postprocess the particular loudspeaker signal and the result signal from (AM1) and (AM2) is connectable to the particular summation point.

9. Device for operating voice-supported systems as claimed in claim 8, characterized in that the acoustic models (AM1, AM2) comprise means for noise pattern recognition, which serve for separating engine/driving noises from voice-generated acoustic signals, as well as for separating primarily voice-generated signals from fedback echo signals.

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1 sheet of drawings enclosed

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